Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) with funding from the Department of Agriculture.

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that certain course of action is preferred but not necessarily required.

In the preparation of this standard, Regional Network for Agricultural Machinery (RNAM) Test Codes and Procedures for Farm Machinery, Technical Series No. 12:1983 was considered.

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ANNEXES

Agricultural Machinery – Chipping Machine – Methods of Test

1 Scope

This standard specifies the methods of test and inspection for power-driven and manually-operated chipping machine for root crops and banana. Specifically, it shall be used to:

1.1 verify the mechanism, dimensions, materials, accessories of the chipper and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features;

1.4 analyze the chipped product through laboratory analysis; and

1.5 report the results of the tests.

2 References

The following normative document contains provisions which through reference in this text constitute provisions of these standards:

PAES 103:2000 Agricultural Machinery - Methods of Sampling

PAES 222:2005 Agricultural Machinery – Chipping Machine - Specifications

3 Definitions

For the purpose of this standard, the following definitions shall apply:

3.1
blade bevel angle
angle of the cutting edge of the blade

3.2
chip
thin slice of material with thickness of about 4 mm

3.3
chipping machine
chipper
size reduction machine either power or manually operated which is used to cut or slice root crops or banana into small thin pieces called chips

3.4
chipping capacity
amount of material that can be processed per unit time, kg/h

3.5
chipping efficiency
ratio of the weight of the chips collected at all outlets, to the total weight of the input of the chipper, expressed in percent

3.6
chipping recovery
ratio of the weight of the chips collected at the main outlet, to the total weight of the input of the chipper, expressed in percent

3.7
cutting disc
rotating part of the chipping machine that holds the cutting knives

3.8
foreign matter
all matters other than root crops/banana such as sand, gravel, dirt, pebbles, stones, metal fillings, lumps of earth, clay, mud, chaff, straw, weed seeds and other crop seeds

3.9
overall height
distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the chipping machine

NOTE All parts of the chipping machine projecting upwards are contained between these two planes.

3.10
overall length
distance between the vertical planes at the right angles to the median plane of the chipping machine and touching its front and rear extremities

NOTE All parts of the chipping machine, in particular, components projecting at the front and at the rear are contained between these two planes. Where an adjustment of components is possible, it shall be set at minimum length.

3.11
overall width
distance between the vertical planes parallel to the median plane of the chipping machine, each plane touching the outermost point of the chipping machine

NOTE All parts of the chipping unit projecting laterally are contained between these two planes.

3.12
plate angle
angle of orientation of the chipping plate with respect to the horizontal plnae

3.13
primemover
electric motor or internal combustion engine used to run the chipping machine

3.14
rake angle
angle of inclination of the blade with respect to the chipping plate

3.15
running-in period
preliminary operation of the machine to make various adjustments prior to the conduct of test until the operation is stable

4 General Conditions for Test and Inspection

4.1 Selection of chipper to be tested

Chipping machine submitted for test shall be sampled in accordance with PAES 103.

4.2 Role of manufacturer/dealer

The manufacturer shall submit specifications and other relevant information about the chipper and shall abide with the terms and conditions set forth by an official testing agency.

4.3 Role of the representative of the manufacturer/dealer

An authorized representative of the manufacturer/dealer shall operate, adjust, repair, and shall decide on matters related to the operation of the machine.

4.4 Test site conditions

The chipping machine shall be tested as installed for normal operation. The site should have ample provisions for crop handling, temporary storage and workspace.

4.5 Test instruments

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the chipping machine test is shown in Annex A.

4.6 Test materials

Test materials to be used shall be commonly or locally grown root crop preferably potato. The amount of test material to be supplied shall be at least 75% of chipper's chipping capacity.

5 Test and Inspection

5.1 Verification of the manufacturer's technical data and information

5.1.1 This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the chipping machine in comparison with the list of manufacturer's technical data and information.

5.1.2 A plain and level surface shall be used as reference plane for verification of chipping machine's dimensional specifications.

5.1.3 The items to be inspected and verified shall be recorded in Annex B.

5.2 Performance test

5.2.1 This is carried out to obtain actual data on machine performance.

5.2.2 Initial data of the crop conditions such as type of crop, variety, and source shall be recorded.

5.2.3 Test materials to be used

Test materials prepared to be used for the running-in and for each test trial shall be the same.

5.2.4 Running-in and preliminary adjustment

Before the start of the test, the chipper should have undergone running-in period wherein various adjustments of the chipper shall be made according to the recommendation of the manufacturer. (No other adjustments shall be permitted while the test is on-going).

5.2.5 Termination of test

If during the test run, the machine stops due to major component breakdown or malfunctions the test shall be terminated by the test engineer.

5.2.6 Operation of the chipping machine

The chipping machine shall be operated at the speed(s) and feed rate(s) recommended by the manufacturer. The same recommended feeding rate shall be maintained during the test run. After the test run, the area shall be cleaned and then prepared for the next trial. This procedure shall be repeated for the succeeding test trials.

5.2.7 Test trial

A minimum of three test trials, with duration of at least 15 minutes per trial, shall be adopted.

5.2.8 Data collection

5.2.8.1 Duration of test

The duration of each test trial shall commence at the start of the chipping operation and ends after feeding of the last batch and it shall be recorded as operating time.

5.2.8.2 Noise level for power-operated chipping machine

The noise emitted by the machine shall be measured using a noise level meter at the location of the operators and baggers. The noise level shall be measured 50 mm away from the ear level of the operators and baggers.

5.2.8.3 Speed of components

The speed of the rotating shafts of the major components of the chipper shall be taken using a tachometer.

NOTE Measurements shall be taken with and without load for sub-clauses 5.2.8.2 and 5.2.8.3 as specified in Annex C.

5.2.8.4 Power/Fuel consumption for power-operated chipping machine

A power meter shall be used to measure electric energy consumption. In case an internal combustion engine is used, the fuel tank shall be filled to its capacity. After each test trial the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test. When filling up the tank, keep the tank horizontal so as not to leave empty space in the tank.

5.2.8.5 Operator's physical attributes for manually-operated chipping machine

Height, weight and stature of the operator shall be recorded. Pulse rate and blood pressure before and after each test trial shall be recorded.

5.2.8.6 Data recording and observations

Record sheet for all data and information during the test is given in Annex C.

5.2.9 Sampling

5.2.9.1 Sampling procedures for test materials

Randomly take 20 representative samples for determination of input material dimension. This is done by taking samples, each at the top, middle and bottom of the pile.

5.2.9.2 Sampling from the outlet

During each test trial, three-200 g samples shall be randomly collected from the output of the chipper to be analyzed in the laboratory. Half (100 g) of the 200 g sample shall be used for

laboratory analysis and the other half (100 g) shall be used for reference purposes or for an eventual second check in case of review.

5.2.9.3 Handling of Samples

All samples to be taken to the laboratory shall be placed in appropriate containers and properly labeled.

6 Laboratory Analysis

Laboratory analyses shall be made to determine work quality, accuracy, and precision of the chipper. The laboratory test data sheet to be used is given in Annex D.

6.1 Moisture content

6.1.1 This shall be taken using oven-dry method.

6.1.2 For each test trial, weigh three-100 g of chipped materials, place in the moisture can and record the weight. Ensure that no moisture is lost or gained by the sample between the time it was collected and when it is weighed in a moisture can. Record the initial weight.

6.1.3 Dry the sample in the oven with temperature of 103 ^{o}C $\pm$ 1 ^{o}C for 72 h.

6.1.4 After removing the samples from the oven, the moisture can with the samples should be placed in a desiccator and allowed to cool to the ambient temperature.

6.1.5 Weigh the moisture can plus the dried sample. Record the final weight. Calculate the moisture content using Equation E.1 in Annex E.

6.2 Analysis of products

6.2.1 Determination of work quality

In each test trial, take three-250 g samples from the outlet. Sieve the samples to separate crushed materials and to sort the chipped materials. The chips shall be classified into large, medium, and small size. Large size are the chips that retained in 4 mm sieve, medium size are the chips that passed through 4 mm sieve but retained in 2.8 mm sieve and small size are chips that passed through the 2.8 mm sieve but retained in the 250 μm sieve. Chips with the thickness of less than 250 μm shall be considered as crushed. The chips shall be weighed to determine the chipping efficiency.

6.2.2 Determination of size uniformity of chips

In each test trial, randomly take three-30 pieces samples from the outlet. The thickness of each sample shall be measured and recorded. Compute the coefficient of variation and precision (% error) of cut of the chipper using the formula in Annex E.

7 Formula

The formulas to be used during calculations and testing are given in Annex E.

8 Test Report

The test report shall include the following information in the order given:

8.1 Title

8.2 Summary of results

8.3 Purpose and scope of test

8.4 Methods of test

8.5 Conditions of the machine

8.6 Description of the machine

8.7 Results of test

8.8 Observations (include pictures)

8.9 Names, signatures and designation of test engineers

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

	Equipment	Quantity
A.1	**Equipment**	**Quantity**
A.1.1	**Field**	
A.1.1.1	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
A.1.1.2	Digital timers (range: 60 minutes) Accuracy: 0.1 sec	2
A.1.1.3	Tape measure (with maximum length of 5m)	1
A.1.1.4	Noise level meter Range: 30 dB(A) to 130 dB(A)	1
A.1.1.5	Weighing scale (capacity: 100 kg) Scale divisions: 0.5 kg	1
A.1.1.6	Graduated cylinder (for engines) (500 mL capacity) or Watt-hour meter (for electric motors) 60 Hz, 220 V	1
A.1.1.7	Sphygmomanometer	1
A.1.1.8	Thermometer	1
A.1.1.9	Camera	1
A.1.2	**Laboratory**	
A.1.2.1	Weighing scale (Sensitivity: 0.1 g)	1
A.1.2.2	Air oven	1
A.1.2.3	Desiccator	1
A.1.2.4	Caliper	1
A.1.2.5	Aluminum Moisture can	9
A.2	**Materials**	
A.2.1	Sample bags	
A.2.2	Labeling tags which include	
A.2.2.1	Date of test	
A.2.2.2	Chipper on test	
A.2.2.3	Sample source	
A.2.2.4	Variety	
A.2.2.5	Trial number	

Annex B
(informative)

Specifications of Chipping Machine

Name of Applicant/Distributor: _____
Address: _____
Tel No: _____
Name of Manufacturer:_____
Address: _____
Tel No: _____

GENERAL INFORMATION

Brand/Model: _____ Type:_____
Serial No: _____ Make:_____
Production date of chipper to be tested: _____
Testing Agency: _____ Test Engineer:_____
Date of Test: _____ Location of Test:_____

Items to be inspected

ITEMS	Manufacture's Specification	Verification by the Testing agency
B.1 Main structure		
B.1.1 Overall dimensions, mm		
B.1.1.1 length		
B.1.1.2 width		
B.1.1.3 height		
B.1.2 Weight, without primemover (kg), if applicable		
B.2 Loading hopper		
B.2.1 Dimension, L x W, mm		
B.2.2 Capacity, kg		
B.2.3 Material of construction		
B.3 Chipping assembly		
B.3.1 Chipping plate		
B.3.1.1 Diameter, mm		
B.3.1.2 Thickness, mm		
B.3.1.3 Plate angle, degrees		
B.3.1.4 Material		
B.3.2 Chipping blade		
B.3.2.1 Type		
B.3.2.2 Dimension, L x W x T, mm		
B.3.2.3 Shape		
B.3.2.4 Bevel angle, degrees		
B.3.2.5 Rake angle, degrees		
B.3.2.6 No. of blades		
B.3.3.7 Means of attachment		
B.3.3.8 Material		
B.4 Safety devices		

ITEMS	Manufacture's Specification	Verification by the Testing agency
B.5 Special features		
B.6 Primemover		
B.6.1 Engine		
B.6.1.1 Brand		
B.6.1.2 Model		
B.6.1.3 Serial number		
B.6.1.4 Type (stroke/ignition)		
B.6.1.5 Rated power, kW		
B.6.1.6 Rated speed, rpm		
B.6.1.7 Cooling system		
B.6.1.8 Starting system		
B.6.1.9 Weight, kg		
B.6.2 Electric motor		
B.6.2.1 Brand		
B.6.2.2 Type		
B.6.2.3 Make or manufacturer		
B.6.2.4 Serial number		
B.6.2.5 Rated power, kW		
B.6.2.6 Rated speed, rpm		
B.6.2.7 Phase		
B.6.2.8 Voltage, V		
B.6.2.9 Current, A		
B.6 .2.10 Frequency, Hz		

Annex C
(informative)

Performance Test Data Sheet

Test Trial No. _____ Date:_____
Test Engineer: _____ Location:_____
Assistants: _____ Test Specimen:_____
Test Requested by:_____ Manufacturer: _____

ITEMS	Trial 1	Trial 2	Trial 3	AVE.
C.1 Conditions of test sample				
C.1.1 Crop				
C.1.2 Variety				
C.1.3 Source				
C.1.4 Moisture content, %				
C.2 Machine condition				
C.2.1 Blade clearance, mm				
C.2.2 Rake angle, degree				
C.2.3 Plate angle, degree				
C.3 Ambient condition				
C.3.1 Dry bulb temperature, ^{o}C				
C.3.2 Wet bulb temperature, ^{o}C				
C.4 Operator's physical attribute (for manually-operated chipping machine)				
C.4.1 Height, m				
C.4.2 Weight, kg				
C.4.3 Stature				
C.4.4 Forward reach, mm				
C.4.5 Others				
C.5 Weight of input, kg				
C.6 Weight of output, kg				
C.7 Operating time, h				
C.8 Chipping capacity, t/h				
C.9 Chipping efficiency, %				
C.10 Speed of components, rpm				
C.10.1 Primemover (for power-operated chipping machine)				
C.10.1.1 Without load				
C.10.1.2 With load				
C.10.2 Chipping shaft				
C.102.1 Without load				
C.10.2.2 With load				
C.11 Noise level, db(A) (for power-operated chipping machine)				
C.11.1 Operator				
C.11.1.1 Without load				
C.11.1.2 With load				
C.11.2 Chip collector				
C.11.2.1 Without load				
C.11.2.2 With load				

ITEMS	Trial 1	Trial 2	Trial 3	AVE.
C.12 Power consumption (for power-operated chipping machine)				
C.12.1 Power, kW				
C.12.1.1 Without load				
C.12.1.2 With load				
C.12.2 Current, A				
C.12.2.1 Without load				
C.12.2.2 With load				
C.12.3 Voltage, V				
C.12.3.1 Without load				
C.12.3.2 With load				
C.13 Fuel consumed, mL (for power-operated chipping machine)				
C.14 Fuel consumption, L/h (for power-operated chipping machine)				
C.15 Pulse rate (for manually-operated chipping machine)				
C.15.1 Before				
C.15.2 After				
C.16 Blood pressure (for manually-operated chipping machine)				
C.16.1 Before				
C.16.2 After				
C.17 Minimum labor requirements				

C.18 Rate the following observations:

Items	Rating*				
	1	**2**	**3**	**4**	**5**
C.18.1 Ease of loading					
C.18.2 Ease of cleaning parts					
C.18.3 Ease of adjusting and repair of parts					
C.18.4 Ease of collecting output					
C.18.5 Ease of transporting the machine					
C.18.6 Safety					
C.18.7 Vibration					

*1 – Very Good
2 – Good
3 – Satisfactory
4 – Poor
5 – Very Poor

C.19 Other observations:

_____
_____
_____

Annex D
(informative)

Laboratory Test Data Sheet

Machine Tested:_____ Analyzed by:_____
Date of Test: _____ Date Analyzed:_____

D.1 Crop dimension (20 sample)

Sample No.	Dimension mm		
	Length	**Width**	**Diameter**
1			
2			
3			
…			
20			
Average			

D.2 Moisture Content Determination (Oven Method)

Item	**Trial 1**			**Trial 2**			**Trial 3**			**Average**
	1	2	3	1	2	3	1	2	3	
Initial weight, g										
Final weight, g										
Moisture content, %										
									General Average	

D.3 Quality of work (500 g)

Item	**Trial 1**			**Trial 2**			**Trial 3**			**Average**
	1	2	3	1	2	3	1	2	3	
a. Weight of crushed chips, g										
b. Weight of whole chips, g										
c. Chipping recovery, %										

D.4 Classification of cut (250 g sample)

Trial	**> 4mm (large-size chips)**	**4 mm – 2.9 mm (medium-size chips)**	**2.8 mm – 251 μm (medium-size chips)**

D.5 Accuracy and Precision of Cut

Thickness setting: _____

Sample	Thickness of sample mm									
	Trial 1			Trial 2			Trial 3			Average
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

Sample	Thickness of sample mm			
	Trial 1	Trial 2	Trial 3	Average
Average Thickness, mm				
Average Coefficient of Variation, %				
Percent Error				

Annex E
(informative)

Formula Used During Calculations and Testing

E.1 Moisture content

$$MC_{wetbasis} = \frac{W_i - W_f}{W_i} \text{ x } 100$$

where:

MC	=	Moisture content, %
W_i	=	Initial mass of the sample, g
W_f	=	Final mass of the sample, g

E.2 Chipping capacity

$$C_C = \frac{W_i}{T_o}$$

where:

C_C	=	Chipping capacity, kg/h
W_i	=	Weight of input material, kg
T_o	=	Total operating time, h

E.3 Chipping efficiency, C_E (%)

$$C_E = \frac{W_i - W_C}{W_i} \; x \; 100$$

where:

W_C is the weight of crushed chips in the sample, g
W_i is the weight of chipped sample, g

E.4 Coefficient of variation

$$Cv = \sqrt{\frac{n\sum x^2 - (\sum x)^2}{n(n-1)}}$$

where:

Cv	=	Coefficient of variation, %
X	=	Value of observation
n	=	Number of observations

E.4 Error

$$E = \frac{\bar{x} - x}{x} x100$$

where:

E	=	Error, %
$\bar{x}$	=	Mean of n values
x	=	Set value

E.5 Fuel consumption

$$F_c = \frac{F_1}{T_o}$$

where:

F_c	=	Fuel consumption, L/h
F_1	=	Amount of fuel consumed, L
T_O	=	Time of operation, h